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(71) Applicant *(for all designated States except US)*: SAPIM AMADA S.P.A. [IT/IT]; Viale Vicenza, 29, I-36045 Lonigo (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: CODATTO, Antonio [IT/IT]; Via Venezia, 21, I-36045 Lonigo (IT).

(74) Agents: SACONNEY, Piero et al.; Jacobacci & Perani S.p.A., Corso Regio Parco, 27, I-10152 Torino (IT).

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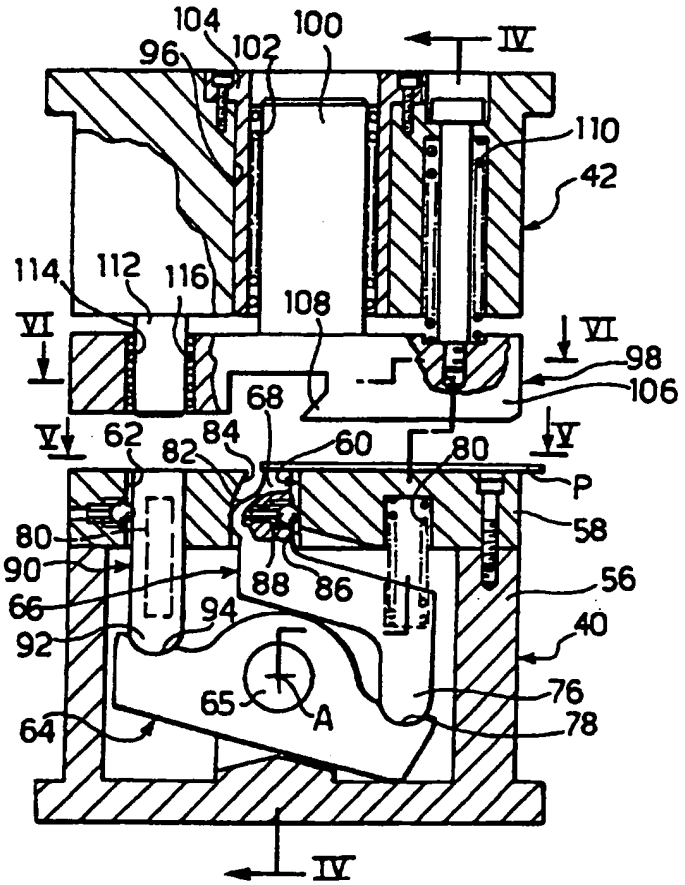
(54) Title: BENDING APPARATUS FOR METAL SHEETS

(57) Abstract

The apparatus comprises two blocks (40, 42) intended to be associated respectively with the fixed part and with the movable part of a press, such as a punching press, to be moved close and moved away mutually. Each block (40, 42) is equipped with a respective blank holder (58; 108). One of the blocks (40) contains a blade-carrier body (66) which bears a bending blade (68). The other block (42) bears a bending counterblade (108) which is capable of interacting with the blade (68). The blade-carrier body (66) is associated, by means of a return member (64), with a driven member (90) turned towards the block (42). This opposite block (42) is provided with a moving member (112) which can be engaged in a thrusting manner with the driven member (90), in the movement of mutual moving close of the two blocks (40, 42), to produce the displacement of the blade-carrier body (66) from a rest position to a work position in which the blade (68) interacts with the counterblade (108). Interposed between the blade-carrier body (66) and the associated block (40) are resilient means (80)for restoring the blade (68) to the rest position.



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Bending apparatus for metal sheets

The present invention relates to a bending apparatus for metal sheets and aims to produce a simple and rugged apparatus intended to be installed between two parts, fixed and movable, of a press.

According to the present invention, this aim is achieved by means of an apparatus, characterized in that it comprises two blocks intended to be associated respectively with the fixed part and with the movable part of the press to be moved close and moved away mutually, in that each block is equipped with a respective blank holder, the two blank holders facing one another, in that at least one of the blocks contains, in a cavity, a blade-carrier body which is movable in relation to the block itself and which bears a bending blade which can be displaced between a rest position in which the blade is retracted in relation to the blank holder belonging to the same block and a work position in which the blade projects in relation to this blank holder, in that the other block bears a bending counterblade which is capable of interacting with the above-mentioned bending blade, in that the blade-carrier body is associated, by means of a return member, with a driven member turned towards the opposite block and this opposite block is provided with a driving member which can be engaged in a thrusting manner with the driven member, in the movement of mutual moving close of the two blocks, to produce, in the course of this movement of moving close, the displacement of the blade-carrier body from the rest position to the work position of the bending blade, and in that resilient means for restoring the bending blade to the rest position are interposed between the blade-carrier body and the associated block.

The invention has been designed in its application to a punching press, illustrated and described in a patent

application filed on the same date by the same applicant for a "Method and machine for the production of sheet metal panels", to which reference is made. However, the invention is not limited to this application and relates to any bending apparatus as claimed, intended to be installed between two parts, fixed and movable, of a press.

For bending metal sheets, use is made of presses the blades and counterblades of which have a length which is greater than that of the edge of the maximum length which it is envisaged bending in the press. The result of this is that, for the majority of the time, the press is used below its capacities: it is in fact not rare that a press having a blade and a counterblade of the length of two metres is utilized for bending the edges of plates of sheet metal, the greatest side of which measures much less than one metre.

On the other hand, a manufacturer of panels may find himself in a situation in which he is required to manufacture panels with bent edges, the sides of which measure more than the length of the blades and counterblades of the presses which he has available. This constrains him to equip himself, even if only for occasional work, with a press of a capacity which is greater than that of the presses which he utilizes for his current production, or constrains him to refuse the work which has been ordered from him.

Thanks to the solution proposed by the invention, it is possible to produce a bending apparatus for metal sheets which, as illustrated and described in the above-mentioned patent application of the same date, can comprise at least one bending blade and one counterblade of small length, for example of a few centimetres. In this manner, it is possible to carry out a bend by successive steps or lengths, for example by translating a panel of sheet metal by steps along the bending apparatus or vice versa by

holding the panel stationary and translating the implement by steps along the bending line. All the relative movements of the tools lend themselves to numerical control to obtain working cycles which are entirely automated and of great versatility.

As illustrated and described in the above-mentioned patent application of the same date, the bending apparatus can be mounted in a punching press with multiple punches with selective control, as a consequence of the simple substitution of a punch and of the associated die with two opposed tool-holding blocks, one movable and the other fixed.

The invention will be understood more clearly by reading the description which follows, made with reference to the attached drawings which are given by way of non-limiting example and in which:

Figure 1 is a diagrammatic perspective view of a machine for the production of panels of sheet metal with bent edges which incorporates a bending apparatus according to the invention,

Figure 2 is a diagrammatic detailed view in perspective, which is partial and partially in section, of the machine in Figure 1, which illustrates an example of the bending apparatus according to the invention,

Figure 3 is a diametral section of a first embodiment of the bending apparatus according to the invention, in a rest state,

Figure 4 is a section thereof made essentially according to the line IV-IV in Figure 3,

Figure 5 is a plan view according to the line V-V in Figure 3,

Figure 6 is a transverse section made essentially according to the broken line VI-VI in Figure 3,

Figures 7 to 13 are sections similar to that in Figure 4, which illustrate on a smaller scale the same bending

apparatus in successive phases of an operation for bending an edge of a panel of sheet metal,

Figure 14 is an elevational view in partial section of a second embodiment of a bending apparatus according to the invention, in a rest state,

Figure 15 is a section thereof made essentially according to the broken line XV-XV in Figure 14,

Figure 16 is a plan view according to the arrow XVI in Figure 14, and

Figures 17 and 18 are representations similar to that in Figure 14, which illustrate on a smaller scale the bending apparatus in two successive phases for bending the edge of a panel of sheet metal.

In the drawings and in the associated description, the case has been considered in which the panels of sheet metal are arranged horizontally and the bending apparatus acts on these with vertical movements, but the invention is applicable irrespective of the lying positions of the movable parts and of the directions of their movements in space.

Referring to Figure 1, a punching machine comprises a robust, fixed, essentially C-shaped frame 10 with two parts, opposite one another, integral and spaced. One of these parts is a greater lower arm 12 while the other is a smaller upper arm 14.

The lower part 12 serves as a base for a manipulator which is generally designated by 16.

The manipulator 16 comprises a horizontal support plane 18, for example of the known ball-type. The support plane 18 serves to support panels of sheet metal, like the panels P represented in Figure 2, in the operations of loading and unloading the machine, as well as during the operations of bending in the machine itself.

For details of the manipulator 16, reference is made to the patent application of the same date of the applicant

for a "Method and machine for the production of sheet metal panels". For the purposes of the present invention, it will be sufficient to say that the manipulator comprises a pair of movable motorized slides 20 and 22 which reciprocate respectively according to the double arrows X and Y.

The slide 22 bears a pair of grippers 24 which serve to grasp the panels of sheet metal along their edges for transport of the panels themselves in relation to the bending apparatus which will be described further on.

Still referring to Figure 1, each lower part 12 and upper part 14 of the frame 10 bears a respective carousel 26, 28. The two carousels 26, 28 are spaced from one another and are rotatable in unison about a common vertical axis Z_1 which is normal to the horizontal planes defined by the support plane 18 and by the two directions X and Y, and therefore normal to the general plane of the panels which are subjected to bending.

The two carousels 26 and 28 are of the well-known type utilized in multiple-punch punching presses and can be actuated in rotation in unison.

In a known manner, the two carousels 26, 28 bear respectively lower punching dies 30 and upper cooperating punches 32.

Also in a known manner, the upper part 14 of the frame 10 bears a thruster 34. The thruster 34 is movable according to an axis Z_2 parallel to the axis Z_1 by means of a hydraulic or pneumatic actuator (not shown).

The thruster 34 is situated in the zone which is closest to the plane of support 18 and is capable of actuating, in known manner, the punch 32 which, as a consequence of the orientation by steps of the carousels 26 and 28, has been brought into the position below the thruster itself.

Mounted in a pair of aligned seats of the two carousels 26 and 28 is a bending apparatus according to the

invention, which is indicated by 38 in Figure 1 and will now be described in greater detail.

Referring to Figure 2, the apparatus 38 comprises two opposed tool-holding blocks, lower 40 and upper 42. The block 40 is mounted in an axially fixed manner in an associated seat 44, in the form of a cup, which is in turn mounted rotatably in the lower carousel 26.

The upper block 42 is mounted in a seat in the form of a sleeve 46 which is in turn mounted rotatably in the upper carousel 28.

Incorporated in the lower block 40 are a lower blank holder and a bending blade, while the upper block comprises a blank holder which, as will be seen further on, serves as a bending counterblade.

In Figure 2, the apparatus represented in the details in Figures 3 to 13 has been illustrated by way of example.

For now, it will be sufficient to say that the arrangement is such that, when the upper block 48 is situated below the thruster 34, the actuation of this latter downwards brings about the descent of the block 42 in its seat 46.

The descent of the block 42, as will be seen further on, has the effect of clamping between the two blank holders a panel P to be bent. The continuation of the descent of the upper blank holder brings about, as will be seen further on, the ascent of a blade incorporated in the upper block 40, with the consequent execution of a bend.

As has already been said above, the two blocks 40 and 42 are mounted rotatably in respective carousels 26 and 28. For their rotation, the two blocks 40 and 42 are motorized and can be oriented in unison about the vertical axis Z_2 which is parallel to the axis Z_1 and therefore normal to the plane of the panels P to be bent. To control the rotation of the blocks 40, 42, a numerical-control step motor 48, 50 is associated with each block, which controls

the rotation of the associated block by means of a respective toothed belt 52, 54.

The two motors 48, 50 orient in unison about the axis Z_2 the two blocks 40, 42, for the purpose of executing bends either according to lines parallel to X and Y in Figure 1 or according to bending lines not parallel to these axes.

A detailed description of a first embodiment of the apparatus according to the invention will now be made, first making reference to Figures 3 to 6 and then, to describe the functioning thereof, to Figures 7 to 13.

In all the Figures 3 to 13, the same parts are designated by the same reference numbers. Some parts are only indicated with the same reference numbers in Figure 2.

The lower block 40 comprises a hollow cylindrical body 56 in the form of a cup with an upper transverse covering wall in the form of an added plate 58.

As will be better understood further on, the plate 58 constitutes a fixed lower blank holder.

The plate 58 has a central through-opening 60 and a lateral through-opening 62, the function of which will be explained further on.

Situated in the cavity of the body 40 is a return member in the form of a rocker 64, the axis of oscillation of which is indicated by A. The axis of oscillation A is formed by two end pins 65 mounted in the wall of the body 56 by means of associated rolling bearings 65a.

Also mounted in the cavity of the body 56 is a blade-carrier body 66, on which a bending blade 68 is formed in one single piece.

The blade-carrier body 66 has an essentially S-shaped profile with an end part, bearing the blade 68, which extends through the central through-opening 60. An opposite end part 70 of the blade-carrier body 66 has a semi-cylindrical profile and is engaged in the manner of an

articulation in a corresponding essentially semi-cylindrical seat 78 of an associated arm of the rocker 64.

Interposed between the end part 76 of the blade-carrier body 66 and the plate 58 are resilient means in the form of a pair of helical compression springs 80, the function of which will be explained further on.

The end part, which bears the blade 68, of the blade-carrier body 66 has a follower dorsal surface 82 which interacts with a ramp surface 84 which delimits the opening 60 in a position opposite the blade 68.

In the position facing the ramp surface 84, the opening 60 has a guide surface 86 with which a resilient tappet 88 interacts, which is incorporated in the corresponding end part of the body 66. The tappet 88 ensures that the follower surface 82 is kept in engagement, pressed resiliently against the ramp surface 84.

As will be observed, the active edge of the blade 68 is parallel to the axis A of oscillation of the rocker 64. Moreover, the blade-carrier body 66 is shaped in such a manner that its blade 68 is essentially aligned, in the direction of relative movement of the blocks 40 and 42, with the axis of oscillation A of the rocker 64.

Mounted slidingly in the lateral opening 62 of the plate 58 is a perpendicular plate 90 which, as will be better understood further on, serves as a tappet or driven member. A lower end 92 of the plate 90 has a semi-cylindrical shape and is coupled in the manner of an articulation in a corresponding essentially semi-cylindrical seat 94 of the arm of the rocker 64 opposite that on which the blade-carrier body 66 is articulated.

The other tool-holding block 42 has an annular cylindrical shape with an axial cylindrical cavity 96.

Associated with the block 42 is a plate 98 with an upper central cylindrical end piece 100. The end piece 100 is mounted slidingly in the cavity 96 by means of a ball

bushing 102 and a sleeve 104.

The plate 98 bears at the bottom an upper blank holder 106 intended to interact with the lower blank holder constituted by the plate 58 below.

The upper blank holder 106 is provided with a nose 108 which is situated in the region of the central opening 60 of the plate 58 and serves as bending counterblade.

The plate 98 and its blank holder 106 are pushed back in relation to the upper block 42 by resilient means constituted by a pair of helical compression springs 110.

Extending from a lower face of the block 42 turned towards the plate 98 is a moving member constituted by a cylindrical thruster 112 which is integral with the block 42. The thruster 112 extends in a sliding manner through a through-hole 114 of the plate 98, with the interposition of a ball bushing 116. The thruster 112 is situated on the vertical of the tappet or driven member 90.

A description will now be given of an operation of bending an edge of a panel or plate of sheet P by referring to Figures 3 and 7 to 13.

In Figure 3, the block 42 is raised, as it is not being thrust downwards by the thruster 34 in Figure 1. Interposed between the two blank holders 58 and 106 is a plate of sheet metal P, with one of its edges to be bent situated in position above the opening 60. The springs 80 keep the equipment contained in the lower block 40 in the arrangement in Figure 3, in which the blade 68 is retracted within the opening and the upper end of the tappet 90 is situated level with the upper face of the plate 58.

In Figure 7, the thruster 34 in Figure 1 has made the upper block 42 descend as far as the point at which the upper blank holder 106 has come to be applied resiliently to the sheet P by pinching it between itself and the lower blank holder 58.

The equipment contained in the lower block 40 has

maintained the arrangement in Figure 3.

In Figure 8, the descent of the upper block 42 is continued under the thrust of the thruster 34 in Figure 1. The driving member 112 has engaged in a thrusting manner the yielding member and has brought about the descent thereof with a consequent incipient rotation of the rocker 64. The latter, in turn, has brought about the incipient ascent of the blade-carrier body 66 counter to the force of the springs 80, and the blade 68 has started to bend the edge of the panel P.

Figures 9 to 12 illustrate the continuation of the bending until the execution of a right-angled bend on the edge of the panel P.

As will be understood, the increase in the bending has taken place thanks to the progressive descent of the driven member 90, under the thrust of the driving member 112, and the consequent progressive ascent of the blade-carrier body 66 and of its blade 68.

During this ascent movement, the follower surface 82, sliding on the ramp surface 84, has brought about a progressive moving of the active edge of the blade 68 close to the interacting counterblade 108 (towards the right in the figures), which contributes to the execution of a correct bend.

The bending of the edge of the sheet P could continue beyond the right angle with a further raising of the blade 68 and further moving of it close to the counterblade 108, to a position above the counterblade itself, within the limits allowed by the geometry of the latter.

In Figure 13, as a consequence of the return of the thruster 34 in Figure 1 to the raised position, all the apparatus has returned to the conditions in Figure 3 and the sheet P with its bent edge can be extracted from the space between the two blank holders 58 and 106. The springs 80 have ensured that the equipment contained in the lower

block 40 has been brought back to the arrangement in Figure 3.

The apparatus shown lends itself to bending of the edge of a sheet by successive segments or lengths, as described in the patent application filed on the same date by the applicant "Method and machine for the production of sheet metal panels". To this end, as illustrated in Figure 5, the end edges of the blade 68 are beveled, as indicated at 68a.

Thanks to this expedient action, with a blade 68 and a counterblade 108 having a length of a few centimetres (for example 10 cm), it is possible to bend by successive steps an edge of a length greater than a metre.

The second embodiment of the bending apparatus, illustrated in Figures 14 to 18, will now be described.

In Figures 14 to 18, the parts which are similar to those of the first embodiment are designated as far as possible by the same reference numbers incremented by 100.

The lower block 140 has an essentially cylindrical upturned-cup shape, with a covering wall 140a in which a wide through-opening 160 is made.

Projecting through this opening 160, in the rest state in Figure 14, is a lower blank holder 158 which constitutes the upper part of a driven member 190, in the form of a slide which can slide vertically in the cavity of the block 140.

The cavity of the block 140 contains a rocker 164 and a blade-carrier body 166.

The slide 190 presses on a corresponding arm of the rocker 164 by means of an articulation rod 190a.

The blade-carrier body 166 is in the form of a right-angled lever with its fulcrum at an intermediate point on the associated arm of the rocker 164. One arm of this right-angled lever 166 extends through the through-opening 160 and bears the bending blade 168. Interposed between

the other arm of the right-angled lever 166 and the wall 140a which has the opening 160 are resilient means in the form of a pair of springs 180.

As in the first embodiment, the arm of the blade-carrier body 166 has a dorsal follower surface 182 which interacts with a ramp surface 184.

The two springs 180 serve both to restore the blade-carrier body 166 to the rest position in Figure 14 and to keep the dorsal follower surface 182 in engagement with the ramp surface 184.

As in the previous embodiment, the blade 168 is parallel to the axis A of oscillation of the rocker 164 and is essentially aligned with this axis A in the direction of relative movement of the blocks 140, 142.

The upper block 142 has a lower end piece 206 in the form of a shoe which serves as blank holder and which has a nose-shaped end piece 208 which serves as bending counterblade.

The arrangement is such that, when the upper block 142 is situated below the thruster 34 in Figure 1, the actuation of the latter downwards brings about the descent of the block 142.

Referring to Figure 17, the descent of the block 142 has in the first place the effect of clamping between the two blank holders 206 and 158 a panel P to be bent.

The continuation of the descent of the block 142 and of the upper blank holder 206 brings about the lowering of the lower blank holder 158, counter to the force of the springs 180. In these conditions, the slide 190, of which the lower blank holder 158 forms a part, serves as driven member and, by means of the rod 190a, brings about a rotation of the rocker 164 with the consequent ascent of the blade-carrier body 166.

In this ascent movement, the interaction of the follower surface 182 of the blade-carrier body 166 and of

the associated ramp surface 184 transforms the course of progressive moving close of the two blocks 140, 142 into a course of progressive moving of the blade 168 close to the counterblade 208, as described for the first embodiment.

Figure 18 illustrates the state of the apparatus at the end of the execution of a 90° bend.

It is understood that, as in the first embodiment, with the apparatus in Figures 14 to 18 it is possible to execute bends of any angle both smaller and greater than 90°, in the second case within the limits allowed by the geometry of the counterblade 208.

In the case of the second embodiment also, as illustrated in Figure 16, the ends of the active edge of the blade 168 have bevels 168a for the use of the apparatus in the execution of bends by successive lengths or segments.

CLAIMS

1. Bending apparatus for metal sheets, intended to be installed between two parts, fixed and movable, of a press, such as a punching press, characterized in that it comprises two blocks (40, 42; 140, 142) intended to be associated respectively with the fixed part (30) and with the movable part (34) of the press to be moved close and moved away mutually, in that each block is equipped with a respective blank holder (58, 108; 158, 208), the two blank holders facing one another, in that at least one of the blocks contains, in a cavity thereof, a blade-carrier body (66; 166) which is movable in relation to the block itself and which bears a bending blade (68; 168) which can be displaced between a rest position in which the blade is retracted in relation to the blank holder (58; 158) belonging to the same block (40; 140) and a work position in which the blade projects in relation to this blank holder, in that the other block (42; 142) bears a bending counterblade (108; 208) which is capable of interacting with the above-mentioned bending blade, in that the blade-carrier body (66; 166) is associated, by means of a return member (64; 164), with a driven member (90; 190) turned towards the opposite block (42; 142) and this opposite block is provided with a driving member (112; 206) which can be engaged in a thrusting manner with the driven member, in the movement of mutual moving close of the two blocks, to produce, in the course of this movement of moving close, the displacement of the blade-carrier body (66; 166) from the rest position to the work position of the bending blade (68; 168), and in that resilient means (80; 180) for restoring the bending blade (68; 168) to the rest position are interposed between the blade-carrier body (66; 166) and the associated block (40; 140).

2. Apparatus according to Claim 1, characterized in that the blade-carrier body (66; 166) is mounted in the

associated block (40; 140) so as to be capable of oscillating towards the counterblade (108; 208) and in the opposite direction, in that said block (40; 140) has a transverse wall (58; 140a) with a through-opening (60; 160), through which an end part of the blade-carrier body (66; 166) extends, which has the bending blade (68; 168), and in that, in a position opposite the blade, the opening (60; 160) has a ramp surface (84; 184) and the blade-carrier body (66; 166) has a dorsal follower surface (82; 182) which interacts with the ramp surface, these surfaces being arranged so as to transform a course of progressive moving close of the two blocks (40, 42; 140, 142) into a course of progressive moving of the blade (68; 168) close to the counterblade (108; 208).

3. Apparatus according to Claim 1 or 2, characterized in that the return member is in the form of a rocker (64; 164) with its fulcrum about an axis of oscillation (A) parallel to the blade (68; 168), the driven member (90; 190) is slidable in the associated block (40; 140) parallel to the direction of relative movement of the two blocks and is coupled with one arm of the rocker (64; 164), and one end of the blade-carrier body (66; 166), remote from the blade (68, 168), is coupled with the other arm of the rocker (64; 164).

4. Apparatus according to Claim 3, characterized in that the blade-carrier body (166) is in the form of a right-angled lever with its fulcrum at an intermediate point on the associated arm of the rocker (164), in that one arm of the right-angled lever (166) extends through the above-mentioned through-opening (160) and bears the bending blade (168), and in that interposed between the other arm of the right-angled lever (166) and a wall (140a) of the block which has the through-opening (160) are resilient means (180) for restoring the blade-carrier body (166) to the rest position and keeping its dorsal follower surface (182)

in engagement with the associated ramp surface (184) of the opening (160).

5. Apparatus according to Claim 3, characterized in that the blade-carrier body (66) has an essentially S-shaped profile with an end part, bearing the blade (68), which extends through the above-mentioned through-opening (60), has the above-mentioned dorsal follower surface (82) and is guided in said opening (60) so as to keep said follower surface (82) in engagement with the associated ramp surface (84) of the opening (60), while an opposite end part (76) of the blade-carrier body (66) is articulated to the associated arm of the rocker (64), and in that interposed between the latter end part (76) and the wall (58) which has the through-opening (60) are resilient means (80) for restoring the blade-carrier body (66) to the rest position.

6. Apparatus according to Claim 5, characterized in that the above-mentioned through-opening (60) has, in the position facing the ramp surface (84), a guide surface (86), with which a resilient tappet (88) incorporated in this end part of the body interacts to keep the follower surface (82) in engagement pressed resiliently against the ramp surface (84).

7. Apparatus according to any one of Claims 3 to 6, characterized in that the blade-carrier body (66; 166) is shaped in such a manner that its blade (68; 168) is essentially aligned, in the direction of relative movement of the blocks (40, 42; 140, 142), with the axis of oscillation (A) of the rocker.

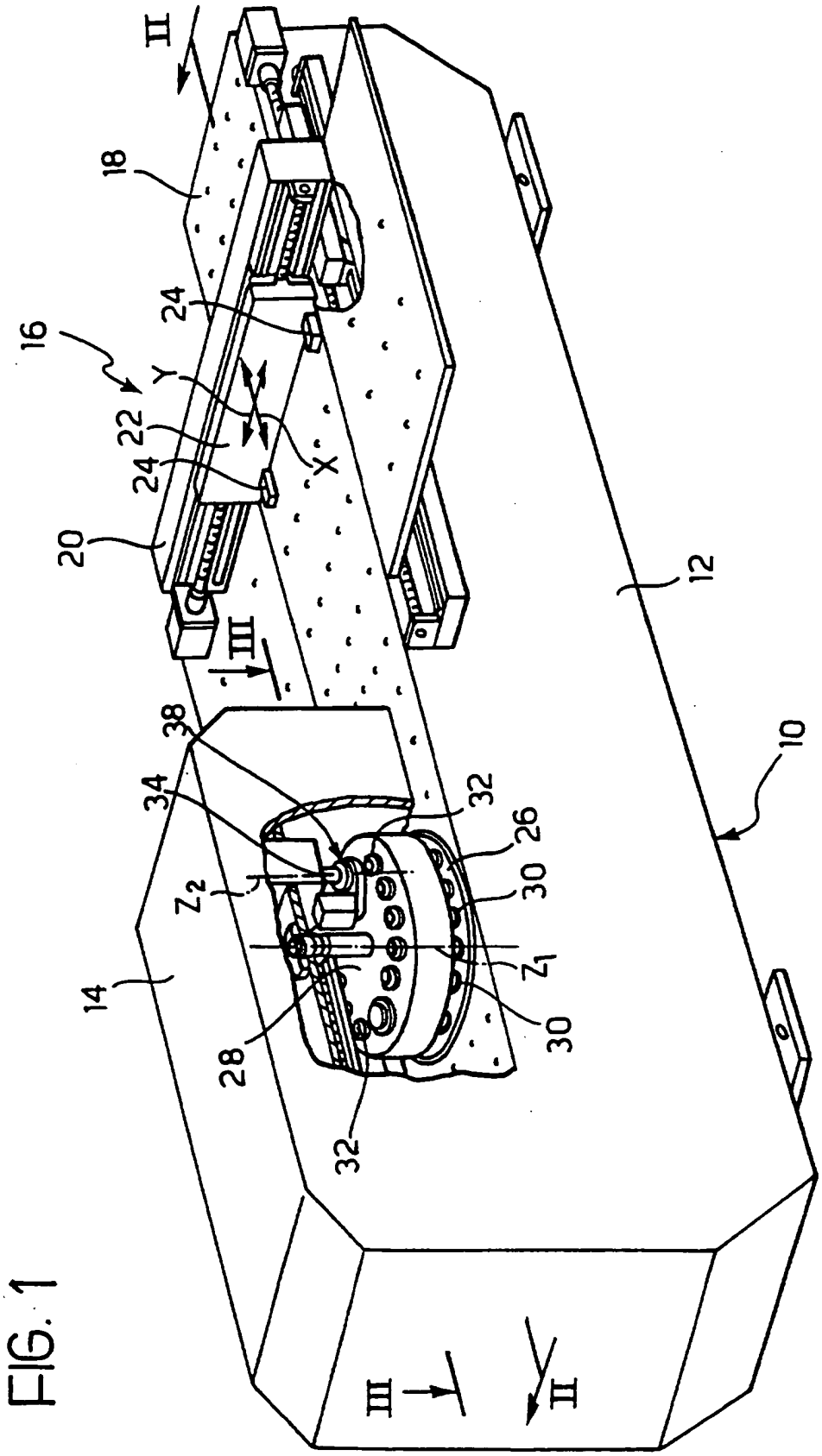
8. Apparatus according to any one of the preceding claims, characterized in that the driven member is in the form of a tappet (90) which is slidable in the associated block (40) and the driving member is constituted by a thruster (112) which is integral with the other block (42) and can be engaged at its tip with the tappet (90).

9. Apparatus according to any one of the preceding

claims, characterized in that the blank holder (106) associated with the block (42) opposite that which contains the blade-carrier body (66) is borne by a plate (98) which is slidable in relation to its block (42) in the direction of mutual moving close of the two blocks (40, 42) and is pushed back by resilient means (110) towards the other block (40) to exert a resilient pressure to restrain the piece of sheet (P) between the two blank holders (58; 108).

10. Apparatus according to any one of the preceding claims, characterized in that the blank holder (106; 206) associated with the block (42; 142) opposite that which contains the blade-carrier body (66; 166) comprises a nose-shaped part (108; 208) which serves as bending counterblade.

11. Apparatus according to any one of Claims 1 to 4, characterized in that the driven member (190) is constituted by a movable body which bears the blank holder (158) of the block which contains the blade-carrier body (166) and the driving member (206) is constituted by the other blank holder.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18
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FIG. 1

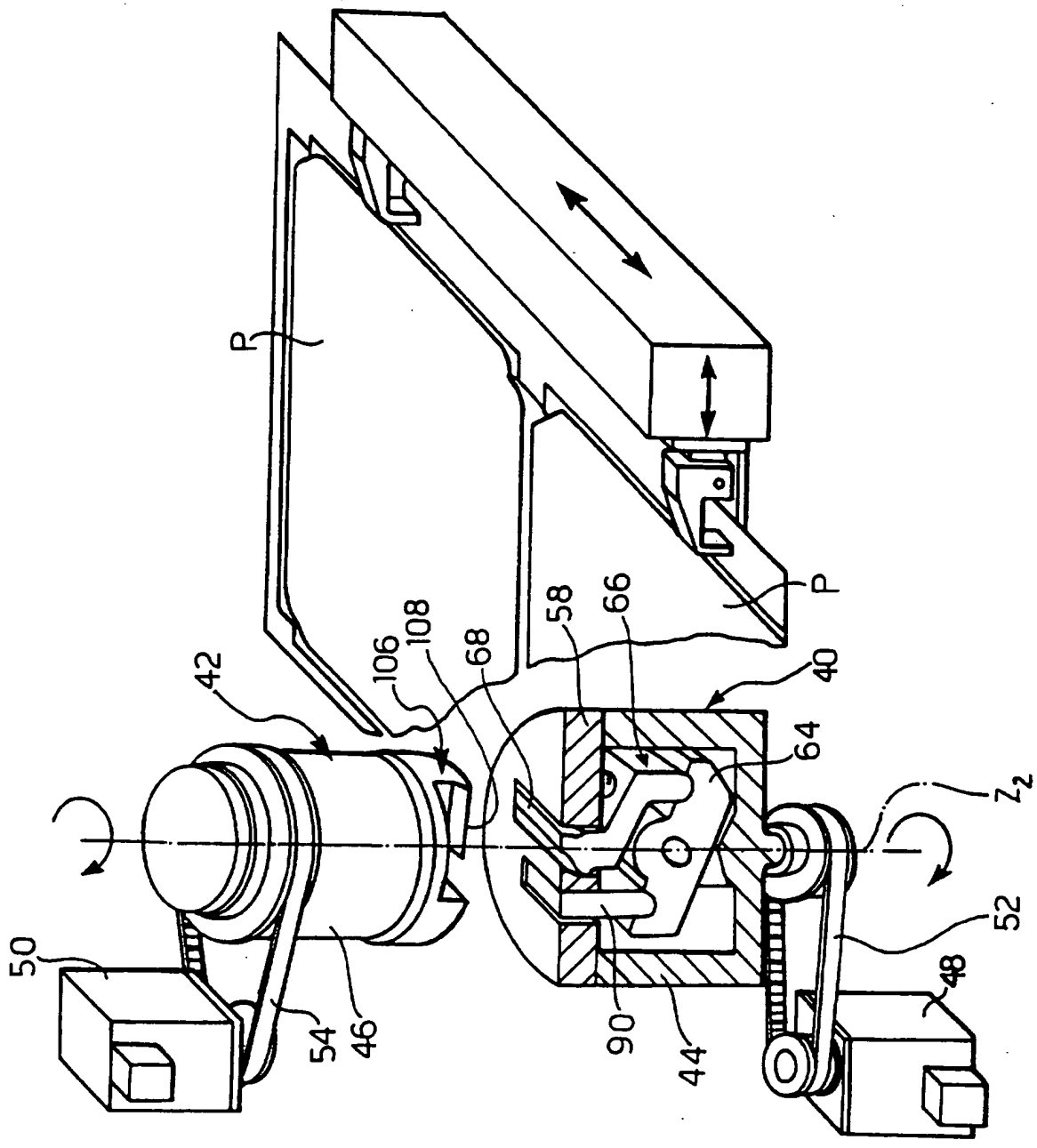
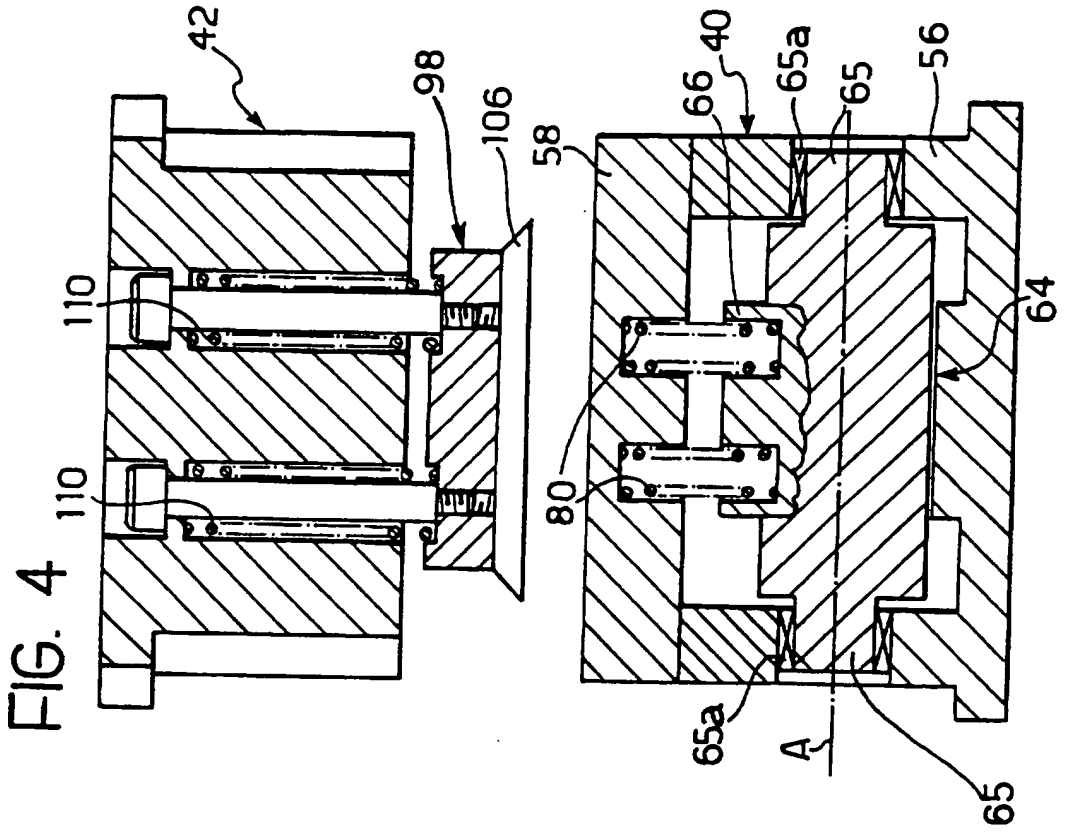


FIG. 2

FIG. 4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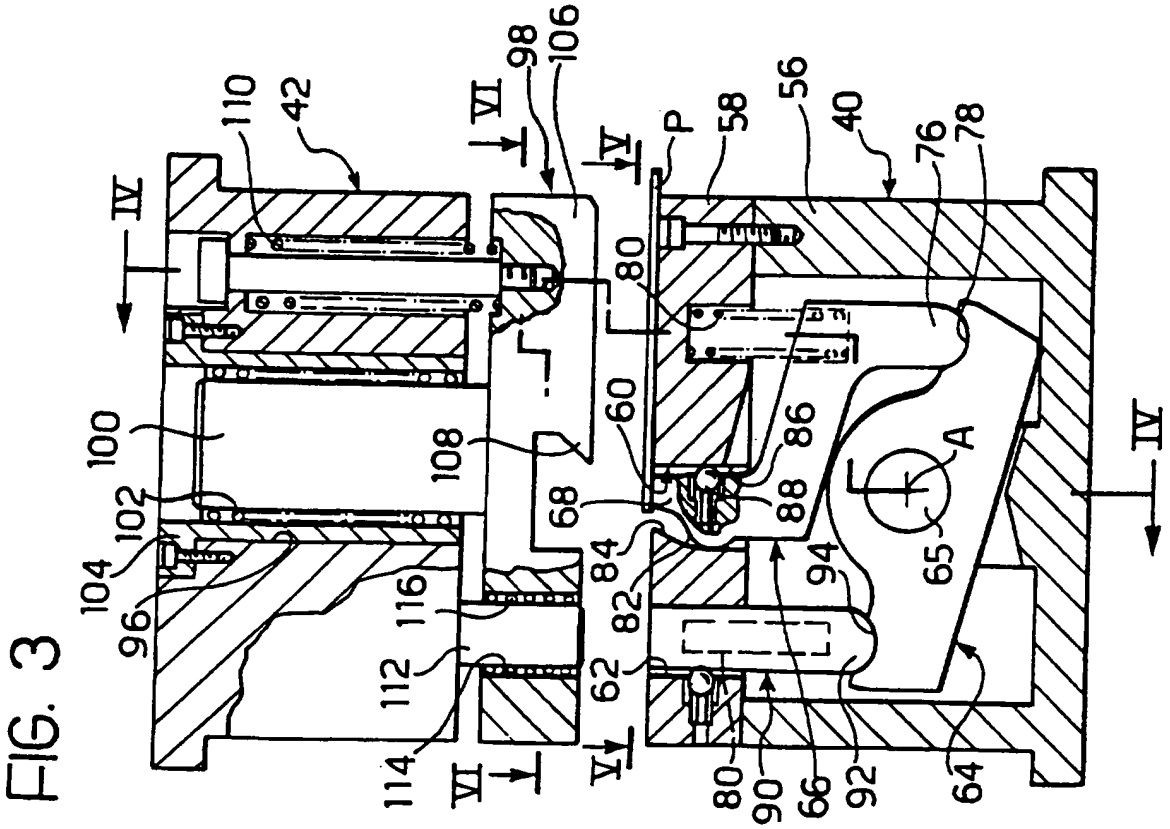
106
110
110
58
66
40
65a
65
56
64
80
65a
A
65

FIG. 3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42
IV
VI
98
106
V
P
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VI
V
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92
64

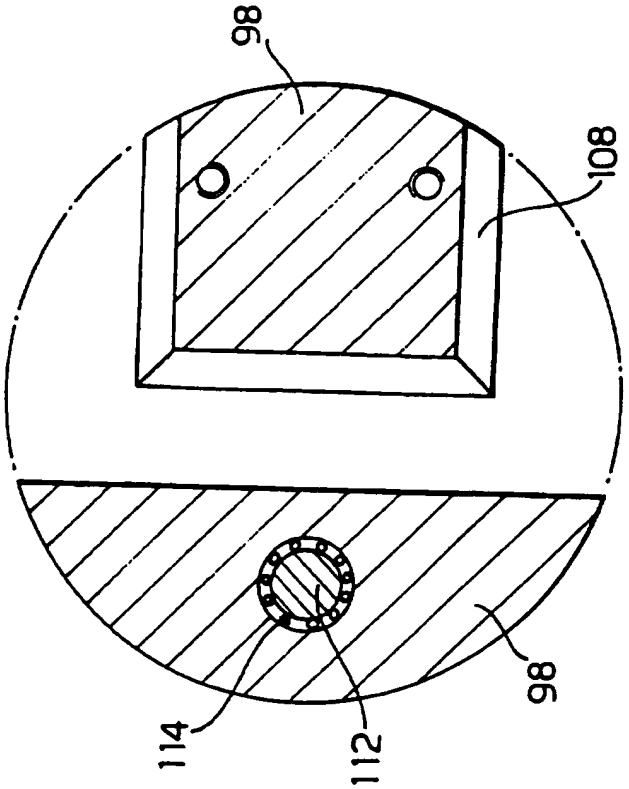


FIG. 6

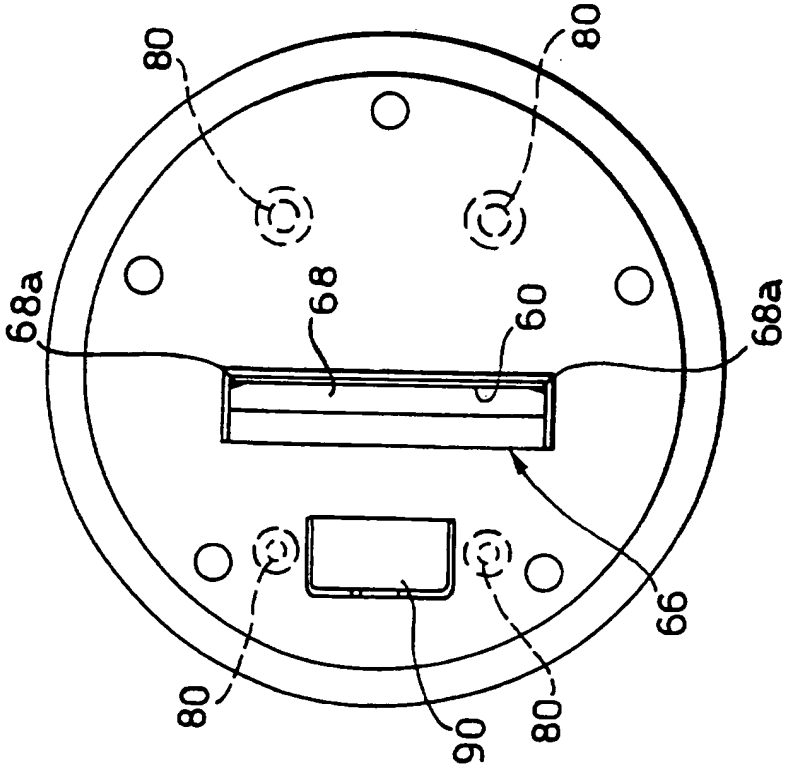


FIG. 5

FIG. 7

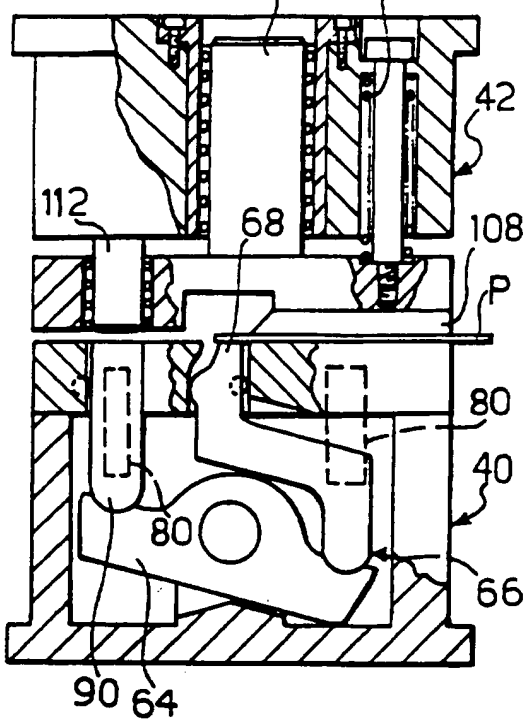


FIG. 8

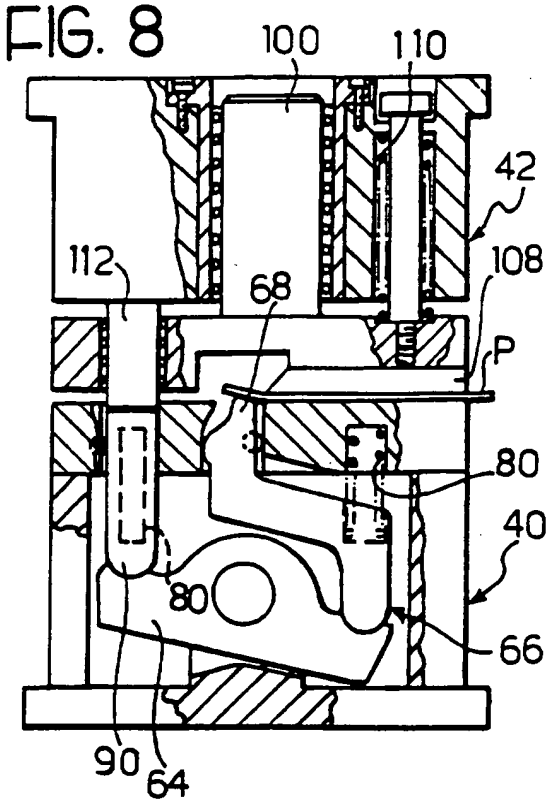


FIG. 9

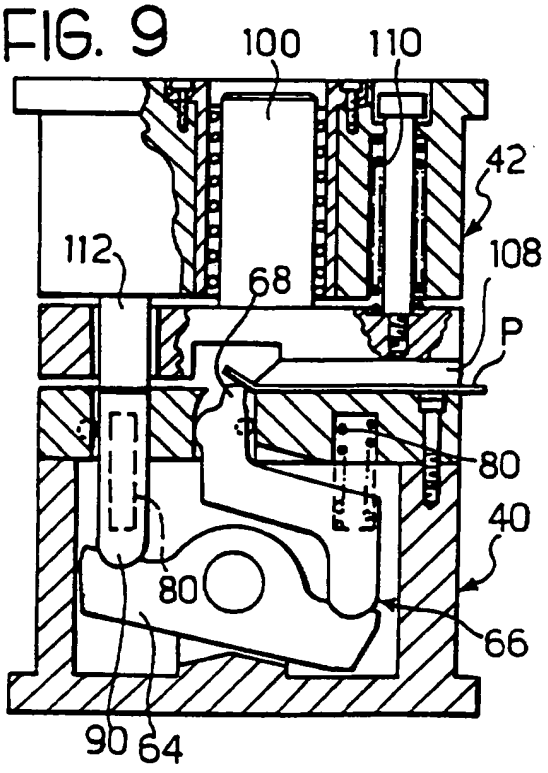


FIG. 10

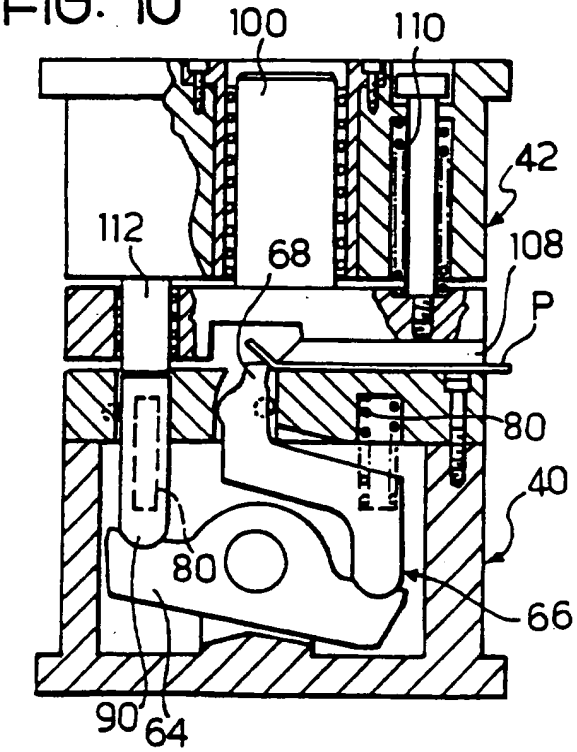


FIG. 11

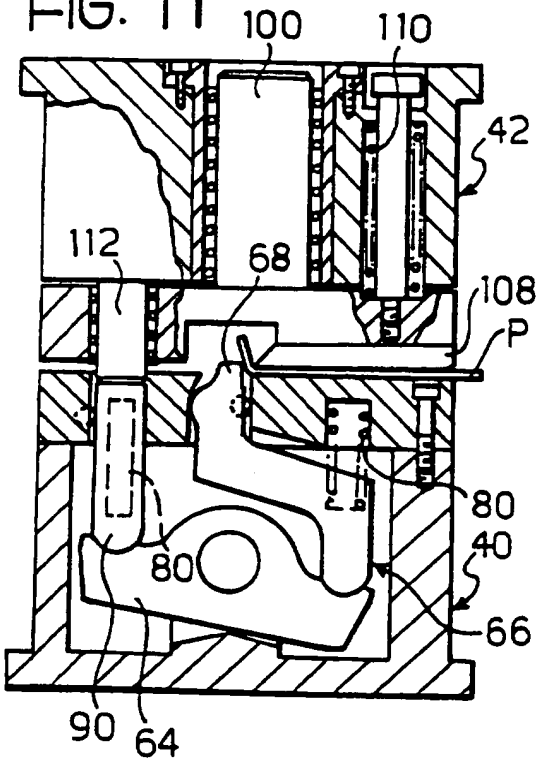


FIG. 12

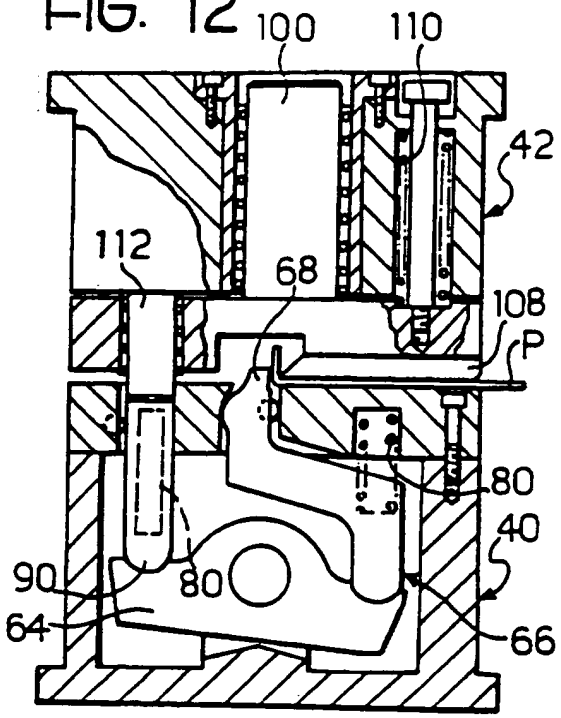


FIG. 13

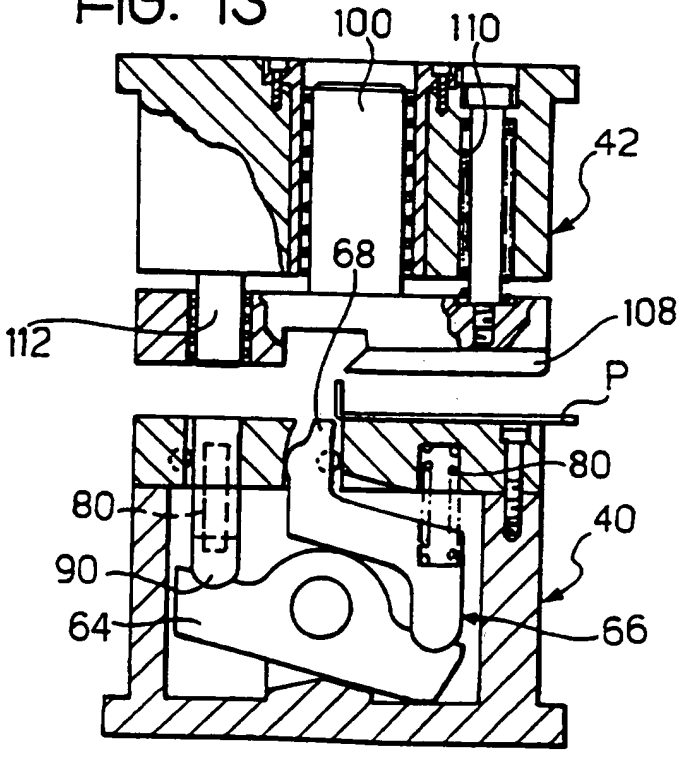


FIG. 15

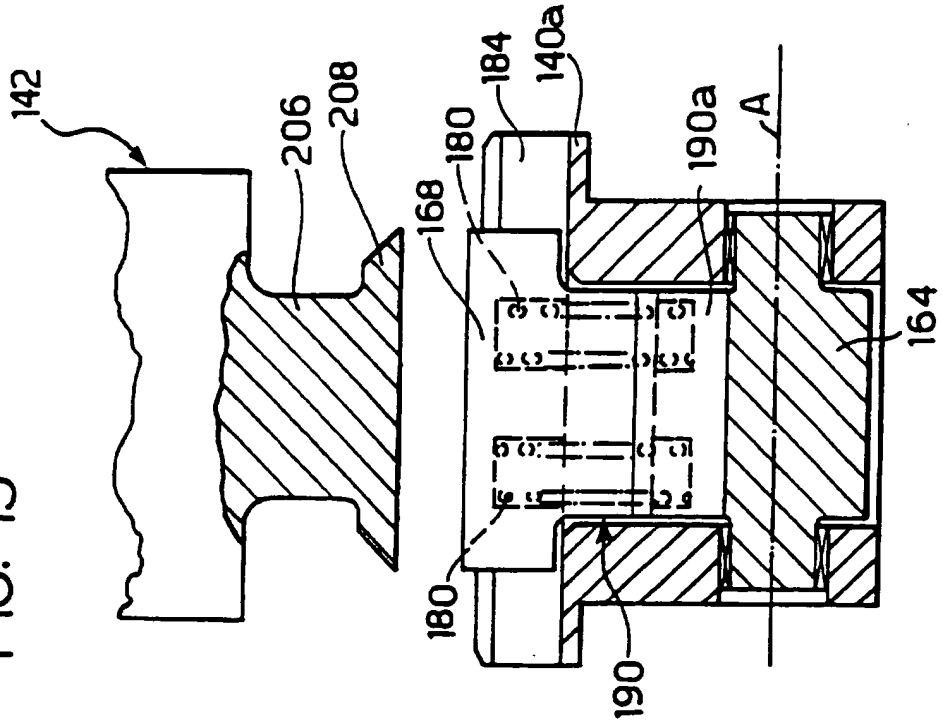
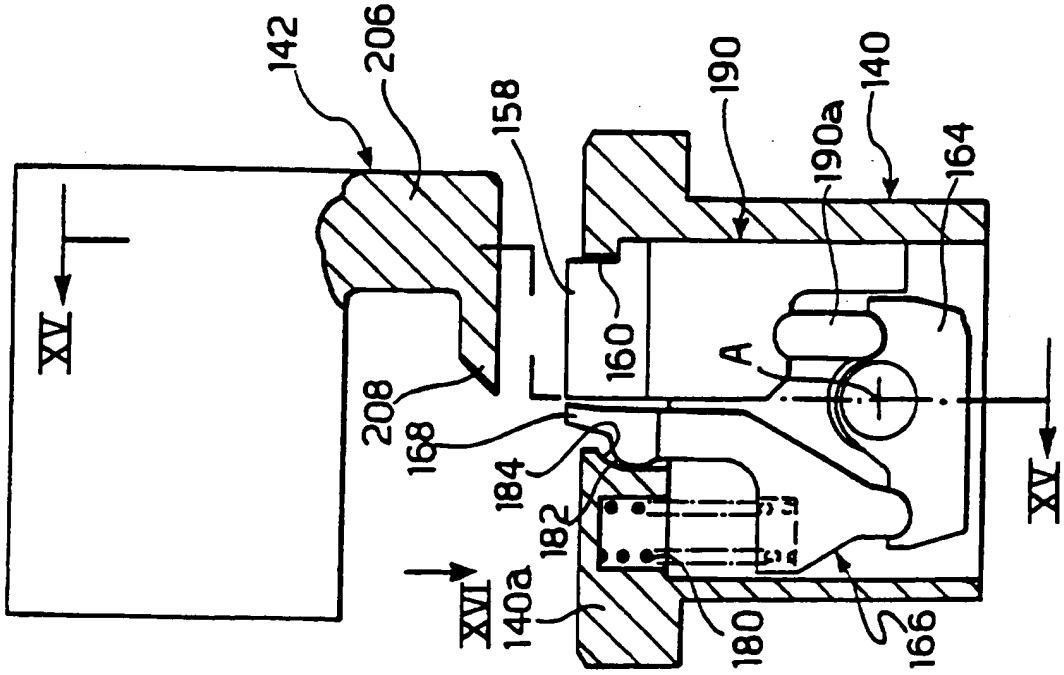

142
206
208
184
140a
180
168
190a
A
164
180
190

FIG. 14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206
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140
164
XV
208
168
160
A
184
182
XVI
140a
180
166
XV

FIG. 16

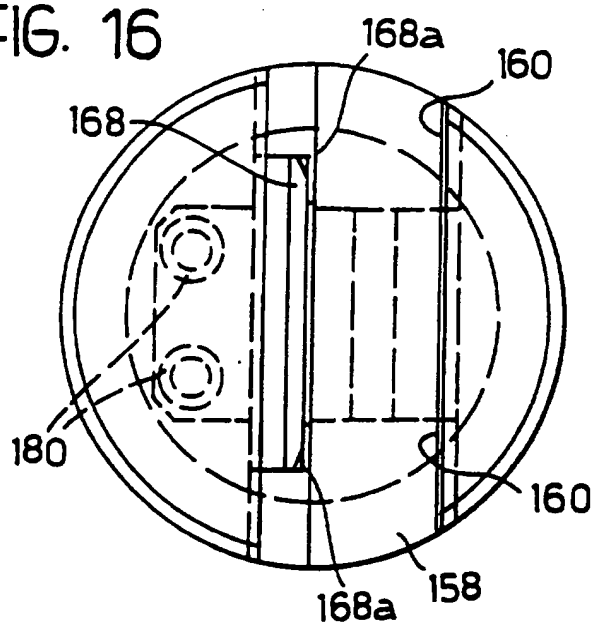


FIG. 17

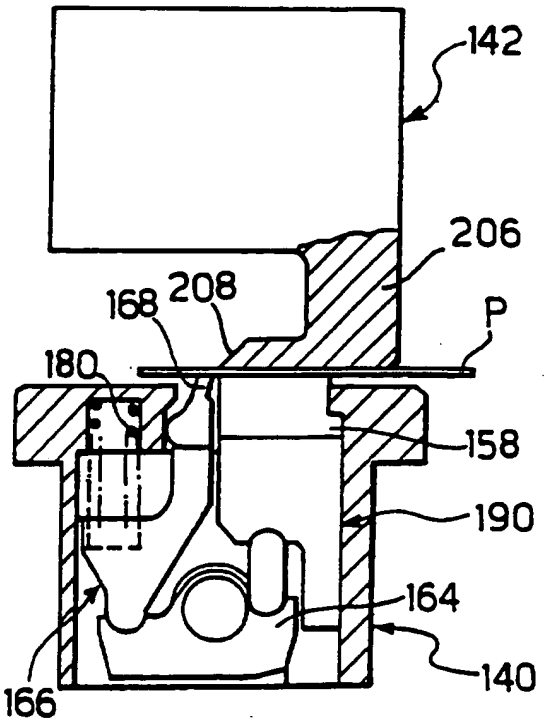
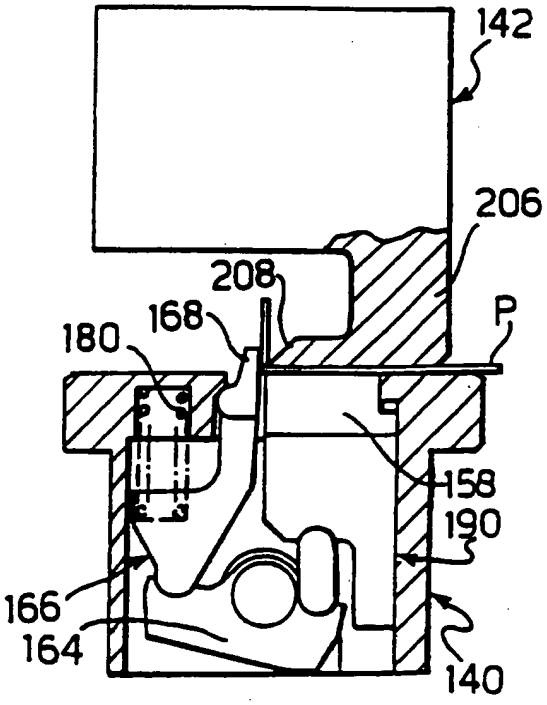


FIG. 18



INTERNATIONAL SEARCH REPORT

Inten .al Application No
PCT/EP 96/00434

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B21D5/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP,A,0 481 426 (AMP INC) 22 April 1992 see figures 2-4	1 2-4,8,9
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 132 (M-303), 20 June 1984 & JP,A,59 033032 (HITACHI SEISAKUSHO KK), 22 February 1984, see abstract	2,4,10
A	EP,A,0 383 176 (MECSTAR S R L) 22 August 1990	11
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 265 (M-258), 25 November 1983 & JP,A,58 145312 (TOYOTA JIDOSHA KOGYO KK), 30 August 1983, see abstract	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
22 April 1996	08.05.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Ris, M

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/EP 96/00434

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 472 (M-1667), 2 September 1994 & JP,A,06 154865 (DAIHATSU MOTOR CO LTD), 3 June 1994, see abstract	1
A	PATENT ABSTRACTS OF JAPAN vol. 013, no. 163 (M-816), 19 April 1989 & JP,A,64 002726 (MARU KIKAI KOGYO KK), 6 January 1989, see abstract	2
A	DE,C,740 600 (WEINGARTEN) 2 September 1943	
A	EP,A,0 555 604 (AMADA CO LTD ;AMADA MANUFACTURING AMERICA IN (US)) 18 August 1993 see figures 13-18	

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inten ..al Application No
PCT/EP 96/00434

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DE-C-740600		NONE		
EP-A-0555604	18-08-93	US-A-	5177843	12-01-93
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